Simulation study of transition from steady Petschek reconnection to dynamical Petschek reconnection

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Magnetic reconnection is a process of converting magnetic energy into thermal energy and kinetic energy. However, classical steady reconnection model (Sweet-Parker model) cannot explain the high speed of reconnection (reconnection rate) observed in the solar corona. Fast magnetic reconnection model has developed to solve this problem. Although the steady Petschek model reconnection can explain the fast reconnection, it requires the localized anomalous resistivity in current sheet. On the other hand, when the resistivity is uniform in space, so-called plasmoid reconnection occurs as the result of instability of a thin current sheet, and reconnection is accelerated. Recently, Shibayama et al. (2015) showed that the plasmoid-type reconnection in uniform resistivity can produce a new-type of fast reconnection with non-steady slow mode shocks, called “dynamical Petschek reconnection.” In this study we have performed two-dimensional magnetohydrodynamics (MHD) simulation to investigate a holistic picture from the steady Petschek reconnection to the dynamic Petschek reconnection. We focused on the dependency of reconnection on the intensity of anomalous resistivity localized in space. As a result of that, we found that there is an oscillating Petschek-type reconnection between the steady Petschek reconnection and the Dynamical Petschek reconnection. We analyze magnetic field in the oscillating Petschek reconnection by decomposing two components of the different parities for mirror symmetry with respective to the current sheet, and discuss the picture of transition from the steady Petschek reconnection to the dynamical Petschek reconnection.

Keywords: magnetic reconnection, Petschek reconnection, simulation, slow shock

